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SECOND MONTHLY PROGRESS REPORT

APRIL 1964

MICRODENSITOMETER CAPABILITY AND INTERPRETATION STUDY

This report covers the second month's activities on a program which consists of a study of microdensitometer capability and interpretation techniques. The three objectives of the program are: (1) the establishment of techniques which will enable a microdensitometer operator to use the instrument to its maximum capability and to interpret the data therefrom accurately (the results of this task will be published as a manual); (2) a survey of existing instruments to study the most recent developments in microdensitometry; and (3) a study of the feasibility and effectiveness of various advances in the state-of-the-art.

Each of the three tasks has been continued during the period covered by this report. As of the end of the month, the percentage expenditure to date was 22%.

I. Mensuration Procedures and Data Interpretation

The investigation of applications of microdensitometry has been continued with particular emphasis on such applications as photographic system performance and photographic photometry. A theoretical investigation of the effect of image motion on the value of resolution obtained from edge scans has been initiated. Preliminary data indicate that the value of resolution obtained from the maximum of the slope of an edge trace is not a good measure of image motion.

Progress has been made on the investigation of the influence of the degree of coherence of the illuminating light upon the images of edges and rectangles. The analysis has led to integrals which must be completed by numerical integration. These integrations are being programmed for the digital computer. Graphs of image intensity distribution for narrow rectangles indicate that greater fidelity can

be achieved at the expense of contrast by placing a central stop in the condenser system. There are also indications that for larger objects increased acutance can be obtained by reducing the numerical aperture of the condensing system relative to that of the analytical system. Further analysis will include examination of the influence of the scanning aperture upon the image and consideration of particular examples for the microdensitometer system.

The dependence of the measured density value on factors such as source and detector specularity, film processing time, and different films sold under
STATINTL the same trade name (e.g. [redacted] is being determined for several density values. The following step wedges have been produced:

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Film	Processing
[redacted]	4 min DK-50 5 min D-19 5 min DK-50 8 min D-19 5 min D-19 2 min D-19 12 min D-19 5 min D-19

The wedges are to be scanned using the following optics:

Objective	
Source	Detector
5X	5X
5	10
5	20
10	10

Objective	
Source	Detector
10X	20X
20	20

The detector eyepiece will be 5X for all cases, and the scanning aperture will be as large as convenient so that fluctuations during the scan are minimized.

II. Equipment Capability

Additional replies to the survey are continuing to be received. The results to date are listed in Table I. A follow-up letter has been sent to the companies

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which have not replied, requesting a reply so that the survey may be concluded. The establishment of microdensitometer evaluation techniques has been continued. Specific tests are being derived. A table is being constructed which summarizes the capabilities of various microdensitometers.

The original technique of reducing a sine wave chart for the purpose of determining the modulation transfer function has proved inadequate. It has been found that the transfer function of the reducing optical equipment decreases the original modulation by about 50%. Since the purchased sine wave chart had a modulation of 30%, the reduced sine wave modulation was about 15%, which will not satisfy test requirements.

A new technique is now being used, whereby a high contrast bar chart is reduced photographically and the higher harmonics are removed by choice of optics and defocusing to produce charts having sinusoidal transmittance. Such charts of 100, 200, and 400 cycles/mm have been prepared and presently their diffraction pattern analysis is being carried out to determine modulation.

III. Feasibility Studies

The primary effort under Task III for this reporting period has been with edge traces and sine-wave test charts.

STATINTL Using an edge of width 0.5 micron generated on the microscope reducer, edge traces have been obtained for the 5X, 10X, 20X and 40X microscope objectives in the [redacted] Model 4 microdensitometer. Computation of the line spread and the modulation transfer function will be done on the IBM 704 computer program that is being prepared.

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